

### **3.4.2 Gulf of Mexico Region**

Participants of the Gulf of Mexico workshop addressed a variety of exploration needs. There was particular interest in topics related to gas hydrates and associated chemosynthetic communities. Discussions extended beyond the traditional interest in hydrates as an energy resource and included issues related to hydrate bed stability and relationships to marine habitats. The participants also placed an emphasis on the interactions between artificial structures (such as oil rigs) and the physical environment, ocean ecosystems, and the welfare of corals and fish.

Significant discussion surrounded the availability of high-resolution bathymetric data in the Gulf of Mexico. It was noted that a significant amount of high-resolution bathymetric data and sub-bottom profiles are held by industry in proprietary databases, but this information is difficult or expensive to access due to its commercial value. There was general agreement that the OE program needed to seek innovative ways of collaborating with industry in the region to facilitate access to these data for exploration purposes.

The group initiated an interesting discussion on the Cayman Trough, an isolated ridge system located south of Puerto Rico. It is small in size when compared to other ridge systems and has been the subject of infrequent observations, making it an ideal target for exploration. Additionally, the ridge was at one time located in the Pacific during its geological history, creating interesting genetic connectivity issues that warrant further investigation. This location was identified during the Caribbean workshop and is represented in Figure 3-1.

Results for the Gulf of Mexico regional workshop are provided in Table 3-4. Exploration targets of interest nominated by workshop participants are illustrated in Figure 3-2.

**Table 3-4. Gulf of Mexico Region Workshop Results**

<b>Gulf of Mexico Workshop</b>	
<b>Standard Package<sup>6</sup>:</b> Class I/II Vessel with acoustic mapping capability (single and multibeam); dive capability (ROV/AUV/ submersible) with imagery/video; sampling equipment and high speed communications; precise positioning system	<b>Standard Partners<sup>6</sup>:</b> USGS; NASA; NOAA; Department of Energy (DOE); Coast Guard; Navy; NSF; NURP; Universities

<b>Gulf of Mexico Workshop Results</b>						
<b>ID</b>	<b>Category</b>	<b>Information Need/Gap</b>	<b>What</b>	<b>Where</b>	<b>Enabling Technologies</b>	<b>Partners</b>
15	Archeology	Archeological sites of historical significance	Location and dynamics of archeological sites of historical significance and cultural sites; wrecks; submerged structures; inventory and characterize what's there; record of sea level change	Candidate sites resulting from prior surveys; edge of Shelf; Bright Banks	Standard Package; Acoustic mapping; single/multibeam; sub/ROVs; Automated Wrecks and Obstructions Information System (AWOIS); video; samples; sub-bottom profiler; SCUBA; sidescan; magnetometers	Standard Partners
41	Artificial Habitats	Offshore man-made structures	Zoogeography of man-made offshore structures - oil and gas structures with time-based observations (depth is a very important component; systematic approach); oil and gas structures; Sargassum mat time-based observations at rigs (modeling; observe before and after mats pass rigs); taxonomy; diversity; distribution	Shelf and deep water; intertidal and subtidal structures	Standard package; Largely diving and ROV's; GIS commercial equipment to collect species from rigs; need industrial strength samplers; low tech recruitment plates; SCUBA; imaging; standard sampling techniques; modeling	Recreational fishing communities; big non-profits such as The Nature Conservancy (TNC); World Wildlife Fund (WWF); Ocean Conservancy; media; British Broadcasting Company (BBC); Discovery Channel; academic institutions; industry; National Geographic; standard; high potential for industrial partners

<b>Gulf of Mexico Workshop Results</b>						
<b>ID</b>	<b>Category</b>	<b>Information Need/Gap</b>	<b>What</b>	<b>Where</b>	<b>Enabling Technologies</b>	<b>Partners</b>
25	Benthic Environment	Biology in deep benthos	Exploring the deep benthos for biological communities; genomic mapping - non-traditional; cataloguing for biotechnology; inventory and characterize live bottom communities; deep Gulf of Mexico is most heavily studied soft bottom in world; sampling; trawls; subs; genetics; Gulf is a marginal basin - distinct zoogeographic province; mapping identifies hard surfaces - can't trawl or box core; imagery; ROV's; subs; geology important; non-chemosynthetic hard bottom poorly studied; looking for topographic highs; lithohierms; lophilia mounds; sink holes - topographic lows - have lots of fish and corals associated with them	Deep Gulf - start at around 200m	Standard Package; Box cores; trawls; subs; standard sampling; trapping; molecular tech; genetic; mapping; development of new technologies that are cost-effective; photographic surveys; ROV's (limited with currents); subs; 3-D/4-D seismic; need better sampling technologies and photographic video gear; correlating arrays; photographic monitoring; in-situ or repeat visits; chemical monitoring; census of organisms with surveys; vertical hydrophone arrays already in Gulf - can hook up with Gulf of Mexico Research Consortium	MMS; NSF; standard funding structure; Florida Marine Research Institute (FMRI); Sea Grant; Mexico; Cuba; Census of Marine Life (CoML); NIH
3	Boundary Fluxes - Air/Sea	Air/sea interactions	Understanding impact of significant weather (hurricanes; tropical cyclogenesis) on deep ocean; characterize ocean under severe weather and ocean bottom in real-time	Tropical storm tracks in Gulf	Video; acoustic mapping; hydrophones; chem./bio sensors; AUV range capability; AUV stationed underwater - "wake up"; time lapse imagery; video; sector scan sonar; hydrophones; ADCP; chemical sensors; acoustic biomass; phosphorescence sensors; genomic probe; optical spectrometer; nutrient sensors; data link; offshore meteorology; satellite data; data buoys; ocean observing systems	NWS (Hurricane Research Division); USN; NMS; NMFS; energy companies; insurance industry; vertical array (ADCP; CTD)
27	Corals - Deep Water	Distribution and status of deep water corals	Diversity; health; size/class distribution; taxonomy	Lophilia Banks - deep coral banks in outer continental shelf- Biosca Knoll; Southern Gulf of Mexico - Sigsbee Knoll and Challenger Knoll	Standard Package; Subs; Alvin or deep ROV	Standard Partners
40	Corals - Shallow Water	Turbid water coral communities	Presence and distribution; morphology	Northern Gulf region; MS River region	Food chain analysis; light meters and other monitoring equipment; water chemistry	Standard Partners

<b>Gulf of Mexico Workshop Results</b>						
<b>ID</b>	<b>Category</b>	<b>Information Need/Gap</b>	<b>What</b>	<b>Where</b>	<b>Enabling Technologies</b>	<b>Partners</b>
5	Currents & Water Masses	Loop currents and circulation	Interaction between loop currents; related circulation features & fisheries; and hydrate stability; impact on ecosystems and habitats; relationship between ocean properties and hydrates/beds; harmful algal bloom (HAB) formation	Yucatan Channel; shelf break along northern & eastern Gulf; loop current and depth <3km; commercial lease tracts	Standard Package; Hyperspectral sensors; ROVs/AUVs (mobility); HDTV; CTDs & hydrophones; vertical array sensors; data link; remote sensing or utilizing vessel (standard package) or fixed sensors & arrays or data mining; fixed & vessel-based ADCPs; tomography; "tailored" AUV; cameras; and sampling tools; sensors for ID nutrients; drifters; profilant floats	Standard Partners; NWS; energy industries
6	Currents & Water Masses	Gulf currents on offshore structures	Understanding of Gulf currents on offshore structures; impact on engineering and design; partnership with platforms	Northern Gulf; energy exploration areas	Instrumented platform; deployed and fixed current meters; drifters; profilant floats	Standard Partners
22	Ecosystem - Abrupt Topography	Cayman Trough	Mapping; plume prospecting; inventory and characterize	Cayman Trough just outside Gulf	CTDs; multibeam	Standard Partners
29	Ecosystem - Abrupt Topography	Lithoherms	Map; identify and characterize; geology	Between Bahamas and Florida	Standard Package; ROV; towed vehicles; AUV's; subs; geophysical technology	Standard Partners
30	Ecosystem - Abrupt Topography	Topographic areas with biological communities	Time observation of topographic areas; revisiting topographic features that have significant biological communities; change in bathymetry; time lapse data	Florida Gulf and Keys; Pinnacles off MS/Alabama; Northwest Gulf; Mexico	Time lapse video to observe activity	Standard Partners
34	Ecosystem - Abrupt Topography	Canyon systems	River-like structures at bottom; microbial communities; geochemical; origin; effects	Orca Basins; smaller brine pools elsewhere; Gulf; MS Canyon	Standard Package; Innovative microbial techniques; sampling techniques; chemical sensors; point sampling with ROV's and subs	Standard Partners
14	Ecosystem - Canyons	Characterize canyon processes	Sediment fluxes; turbidity flow; erosion; chemistry; upwelling	Mississippi Canyon; Desoto Canyon; Green Canyon	Standard Package; ROVs/AUVs/subs; video; sampling	Standard Partners

<b>Gulf of Mexico Workshop Results</b>						
<b>ID</b>	<b>Category</b>	<b>Information Need/Gap</b>	<b>What</b>	<b>Where</b>	<b>Enabling Technologies</b>	<b>Partners</b>
1	Ecosystem - Extreme Environments - Vents, Seeps, & Volcanoes	Hydrates and cold seeps/vents; sediment flows and biota	Understanding the relationship between hydrates and cold seeps/vents and between sediment flows and biota (including microbes) and brine pools; discover new species and processes; understand relationships	Hydrate stability zone; 300m-<~3km; northern Gulf; Campeche Banks and Bay; commercial tracts	Standard Package; 3km capable ROV; synthetic aperture sonar; laser line scanner; pressurized hydrate cores; optical spectrometers; mass spectrometers; HDTV; heat flow sensors; resistivity sensors; reusable biosensors; vertical arrays; resistivity sensors; sea-floor probes; geophones; time lapse imaging; AUV "garage"; data recovery technologies; Vessel (standard package) + high resolution seismic; Fixed sensors; Existing data mining - data bases; Remote sensing -surface expression; AUV; sub; sampling; video; moored application	Standard Partners; Naval Oceanographic Office; Naval Research Laboratory; energy companies
21	Ecosystem - Extreme Environments - Vents, Seeps, & Volcanoes	Chemosynthetic communities	(Subsurface - down several km): oil seeps and vent communities; inventory and characterize; isolated ridge system; new biota; larger geographic context; subsurface 3-D seismic surveys; biogeography (sample); locate plumes	Cayman Trough - major area to explore - lots of unexplored oil seeps; Southern Gulf; Barbados; Trinidad; West Africa - have some taxonomic affinities to those in Gulf of Mexico	Satellite images; oil data; sampling technologies; coring; access industry datasets; chemical sniffers; spectrometers; isotopic work; microbiology; molecular tools; sampling technologies; plume prospecting - do multibeam and then use sensors to look for plumes; standard package; geophysical tools; microbiologists; ecologists; molecular science; towed vehicles; subs; AUV's; look at new technologies	NOAA – Pacific Marine Environmental Laboratory (PMEL); NSF - Ridge Project; National Geographic; Alfred P. Sloan Foundation; International interest; NGO's; USGS; Universities; Mexico; EEZ states; WHOI; HBOI; NSF; MMS; DOE; NASA; ONR; Industry pharmacology; oil and gas; biotech; Mexico
43	Ecosystem - Extreme Environments - Vents, Seeps, & Volcanoes	Montserrat	Hydrothermal activity	Montserrat	Standard Package	Standard Partners
46	Ecosystem - Extreme Environments - Vents, Seeps, & Volcanoes	Neuston	Identify and characterize	Sites of persistency of oil slicks; Bush Hill - Northern Gulf	Satellite; sampling	Standard Partners

<b>Gulf of Mexico Workshop Results</b>						
<b>ID</b>	<b>Category</b>	<b>Information Need/Gap</b>	<b>What</b>	<b>Where</b>	<b>Enabling Technologies</b>	<b>Partners</b>
16	Ecosystem - Shorelines to Ledges	Mississippi River outflow on habitats	Understand the impacts of Mississippi River outflow on habitats; ecosystems (and secondary fresh water input); Determine river influence on Gulf systems; bio/geo/chem; frontal zones	Flower Garden Banks to FL Keys	Standard Package; Physical sampling; hyperspectral; video/HDTV; towed geo/chem/bio sensors; mass spectrometers; geo/chem/bio sensors; nutrient sensors; sensor arrays; fixed sensors; AUVs; remote sensing; ROVs; drifters; vessel	Standard Partners; NMFS; NASA; USN; NOS; Commercial fishing; sport fishing; EPA; states; NMS; U.S. Army Corps of Engineers (USACE)
35	Ecosystem - Shorelines to Ledges	Shoreline erosion	Subsidence in LA; Gulf of Mexico; erosion rates; habitat loss; sedimentation; storm surge impacts; salt water intrusion; habitat loss; impact; invasive species; impacts on infrastructure	Gulf of Mexico; TX; Alabama; coastal LA	Remote sensing; aerial photo; satellite imagery; maps	Standard Partners
13	Episodic Events	Loop and related currents to HAB formation	Understanding of relationship of loop and related currents to HAB formation and other species that are not normally seen; discover mechanisms of transport that leads to formation and distribution	West FL shelf; Yucatan Straits (source); E. Texas; northern Gulf	Remote sensing; towed arrays; ROV/AUVs; sampling; drifters (SVP); HDTV	Standard Partners
36	Episodic Events	Hypoxia phenomenon	Origin; effects	Gulf of Mexico dead zone; look at all river mouths	Collect standard oceanographic parameters	Standard Partners
9	Geology & Geomorphology	Bottom boundary dynamics	Understanding of distribution and process details of fluid and gas expulsions; carbonate formations; and seismic activity; knowledge of bottom boundary dynamics	Slope waters <3km; E. Texas to W FL slope; Continental slope; deep water; shelf; Mexico; Cuba; Florida Keys; Florida Gulf	Standard Package; Seismometers; ROVs/subs; video; sampling; map 3-D seismic data; high resolution data	Standard Partners
11	Geology & Geomorphology	Knowledge of sub-bottom characteristics	Morphology; composition; dynamics	Slope waters <3km	Standard Package; Acoustic sounders (high resolution; seismic); vertical arrays; AUVs	Standard Partners
24	Geology & Geomorphology	Rivers of warm; dense brine	Heat flow measurements; mapping; origin; effects	Sigsbee Escarpment; Orca Basin	Observations; mapping technologies; CTD; acoustics	Standard Partners
39	Geology & Geomorphology	Slope stability studies	Debris floats; gas; slopes; faults; gas hydrates; mud flows; inventory and characterization; date features	Continental slope; Mobile West; Florida escarpment; Sigsbee Escarpment	Standard Package; Geotechnical; sidescan sonar; dating techniques; sampling; core samples; high resolution geophysics; multibeam; sub-bottom systems	Standard Partners

<b>Gulf of Mexico Workshop Results</b>						
<b>ID</b>	<b>Category</b>	<b>Information Need/Gap</b>	<b>What</b>	<b>Where</b>	<b>Enabling Technologies</b>	<b>Partners</b>
45	Geology & Geomorphology	Mega-furrows	Origin; physical characterization over time; size; shape; currents	Found between 5-7;000 feet - base of the Sigsbee Escarpment	High resolution bathymetry; geotechnical technologies	Standard Partners
19	High Resolution Bathymetry	Mapping of the Gulf	Bathymetry	Slopes; shelf regions; western Gulf off Texas coast - East Breaks area; Eastern Gulf; all of Western Florida; 4 reserves closed to fishing - 2 in Tortugas and 2 in West Florida; Northwest Gulf; partner with Mexico to map Yucatan	Standard Package; multibeam; subs for ground truthing; utilize backscatter data; standard package; NOAA database; map; select sites; dives - selectively target between topographic features; subs; AUV's; ROV's; intellectual mapping; time series data	Oil and gas industry; MMS; NMFS; seismic companies; Harte Marine Institute; other existing efforts; USGS; Naval Oceanographic Office; Sea map, Inc.; EPA Gulf of Mexico Program (GOMP); academia; NGO's
20	High Resolution Bathymetry	Mapping between known topographic features	Mapping; inventory and characterization	All over shelf	Mapping technologies; sampling; ROV's; subs; sidescan; towed systems	Standard Partners
10	Human Impacts	Potential threat site location	Location of site of potential threat to the environment and processes near the sites; wrecks; marine debris; dump sites; abandoned platforms	Suspected debris sites; dump zones; wrecks	Standard Package; Sampling (bio/chem/physical); coring; video; acoustic mapper; radiological sensor; networked AUVs; AWOIS; time lapse imagery; video; sector scan sonar; hydrophones; ADCP; chemical sensors; acoustic biomass; phosphorescence sensors; genomic probe; optical spectrometer; nutrient sensors; data link; single/multibeam; sub/ROVs; AWOIS; samples; data mining (data bases); fixed sensors and arrays	EPA; NMS; State Governments; NOS HAZMAT Response Group; media
32	Human Impacts	Anthropogenic noise	Monitoring natural (biological and geological) and anthropogenic noise; effects of human induced noises on biota; natural noise	MS Delta where whales are located; human built platforms; protected regions; essential habitats	Acoustic technologies; new technologies	Standard Partners

<b>Gulf of Mexico Workshop Results</b>						
<b>ID</b>	<b>Category</b>	<b>Information Need/Gap</b>	<b>What</b>	<b>Where</b>	<b>Enabling Technologies</b>	<b>Partners</b>
4	Marine Conservation	Marine Protected Areas	Characterize "deep" Marine Protected Areas (including deep reefs); identify candidate Marine Protected Areas; location & dynamics of archeological sites of historical significance through the use of: vessel (standard package); data mining; manned observatory; fixed sensors and arrays; ID biota that needs protection; habitat characterization	Existing Marine Protected Areas (3 W. FL shelf); Flower Garden Banks; Green Canyon; Mississippi Canyon; Desoto Canyon; PSBL Yucatan Channel	Sub/ROV; deep diving capabilities; manned observatory (human habitat); fixed sensors; AUV; good video; acoustic mapping (single/multibeam); HDTV; synthetic aperture sonar; laser line scanner; data mining technologies; deep water capability; time lapse imagery; data link	Energy companies; NURC; NMFS; Universities; USN; NIH; state governments; commercial fisheries; sport fishing
12	Marine Organisms	Distribution and migration patterns of mega fauna	Understanding distribution and migration patterns of marine mammals; charismatic mega fauna (whales; manta rays; sea turtles; dolphins; whale sharks; etc); response to anthropogenic impacts (noise; other pollution); location; reproduction; general life history questions; genetics	Migration routes; commercial lease tracts (1km contour and loop current events); Gulf shelf; specific topographic features associated with them; man-made platforms	Satellites; various tagging equipment and tech (pop-up; etc); smaller vessels; genetics; endocrinology; biochemistry; Standard package - largely diving and ROV's; GIS commercial equipment to collect species from rigs; need industrial strength samplers; photo equip; ROV's; subs; in-situ cameras; motion sensor cameras; time-lapse cameras; acoustic tags; fixed hydrophones; sensor arrays; tagging; imaging; acoustic; hydro acoustic	Recreational fishing communities; big non-profits such as TNC; WWF; Ocean Conservancy; media; BBC; Discovery Channel; academic institutions; industry
26	Marine Organisms	Genetic connectivity of Gulf ecosystems	Biodiversity; genomic mapping	Upstream and downstream of productive fishery areas – Marine Protected Area's; Keys; Banks; major eddy systems	Genetic technology; plankton tows; traditional sampling techniques; ROV's and subs; deep water collection	Standard Partners
42	Marine Organisms	Exotic invasive species	Where do they come from?; how did they get here?; where are they successful or not successful?; impact; taxonomy; genetics	Everywhere from coast to far offshore regions	Standard sampling; genetics; taxonomy; modeling	Standard Partners
44	Marine Organisms	Cross Gulf migratory birds	Migratory birds - songbirds; contribute to database	Western Gulf mainly; Cuba to Florida	Visual observations; radar	Standard Partners

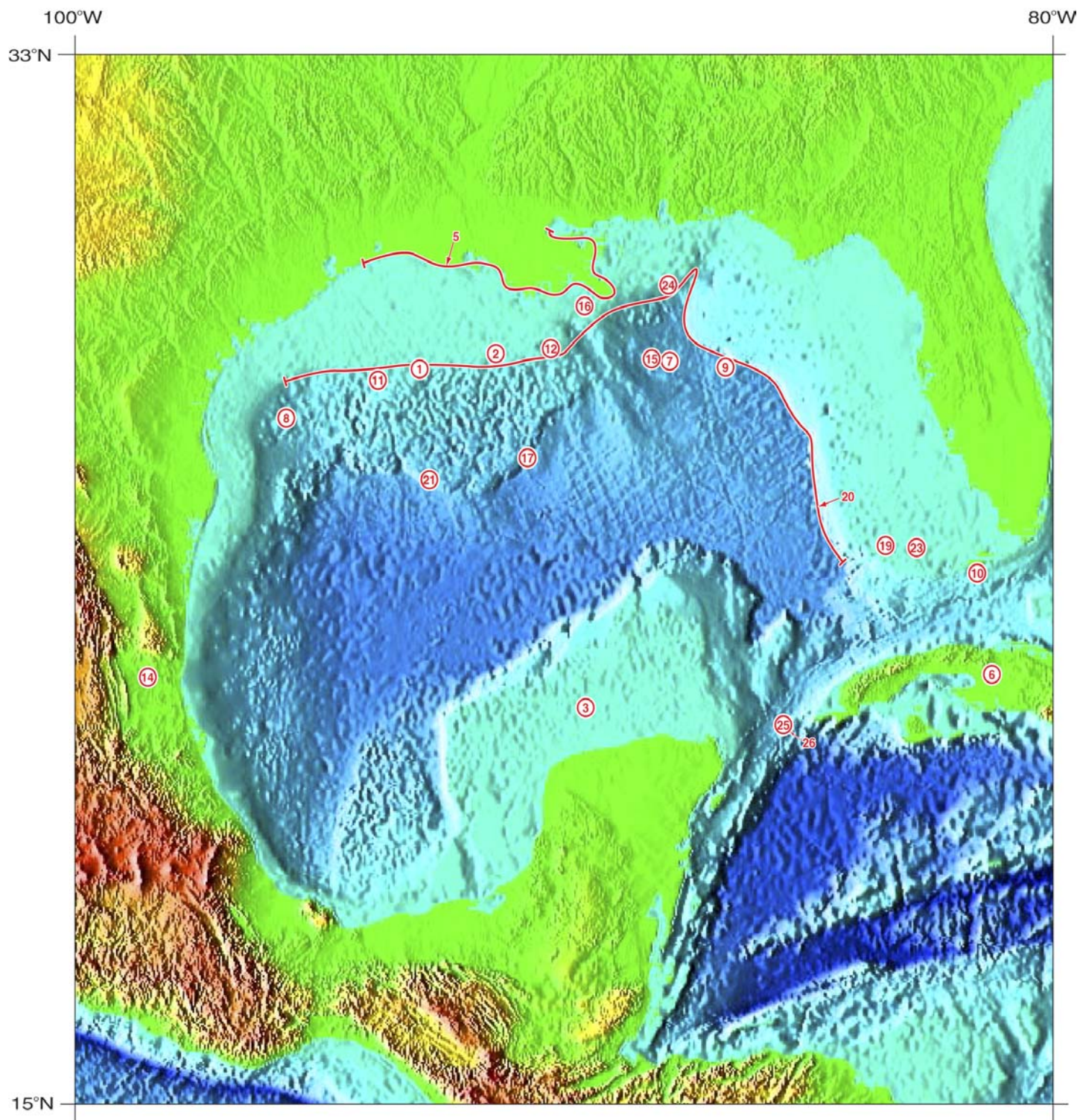


<b>Gulf of Mexico Workshop Results</b>						
<b>ID</b>	<b>Category</b>	<b>Information Need/Gap</b>	<b>What</b>	<b>Where</b>	<b>Enabling Technologies</b>	<b>Partners</b>
2	Ocean Resources - Energy & Minerals	Gas hydrates	Understanding and determination of location and volume of hydrate resources; classification; chemistry	300m-3km (maybe more) depths; emphasize below 1000m (E. Texas to W. Florida); EEZ; outcroppings; arctic	Acoustic mapping; ROVs; sampling systems; video; sub; AUVs; sensors for gas analysis	Standard Partners
17	Ocean Resources - Energy & Minerals	Location of new mineral resource deposits	Shell; sand	EEZ	Core samples; ROVs/AUVs	Standard Partners
18	Ocean Resources - Energy & Minerals	Ocean renewable resources	Ability to generate energy from ocean renewable resources (currents; vents); detailed baseline knowledge of candidate currents/locations	Candidate bathymetry near loop and related currents; vent locations	Instrumented platform; deployed and fixed current meters; drifters; profilant floats	Standard Partners
38	Pelagic Environment	Mid-water exploration	Characterization of organisms	Gulf; off mouth of MS river - resident population of sperm whales over 1000m line so there must be a resident population of giant squid; Straits of Yucatan and Straits of Florida - Gulf connections	Mochness; imagery; sensing; new technologies	Standard Partners

(This page intentionally left blank)

## **Gulf of Mexico Region Exploration Targets of Interest**

1. Bright Banks
2. Bush Hill
3. Campeche Banks
4. Challenger Knoll (not on chart)
5. Coastal Louisiana
6. Cuba
7. DeSoto Canyon
8. East Breaks area
9. Florida Escarpment
10. Florida Keys
11. Flower Garden Banks
12. Green Canyon
13. Lophelia Banks (not on chart)
14. Mexico – areas off Mexico
15. Mississippi Canyon
16. Mississippi Delta
17. Orca Basin
18. Portales Terrace (not on chart)
19. Pulley Ridge
20. Shelf break along northern & eastern Gulf
21. Sigsbee Escarpment
22. Sigsbee Knoll (not on chart)
23. Tortugas Gyre/Portales Gyre
24. Viosca Knoll
25. Yucatan Channel
26. Yucatan Straits



**Figure 3-2. Gulf of Mexico Region Exploration Targets of Interest**